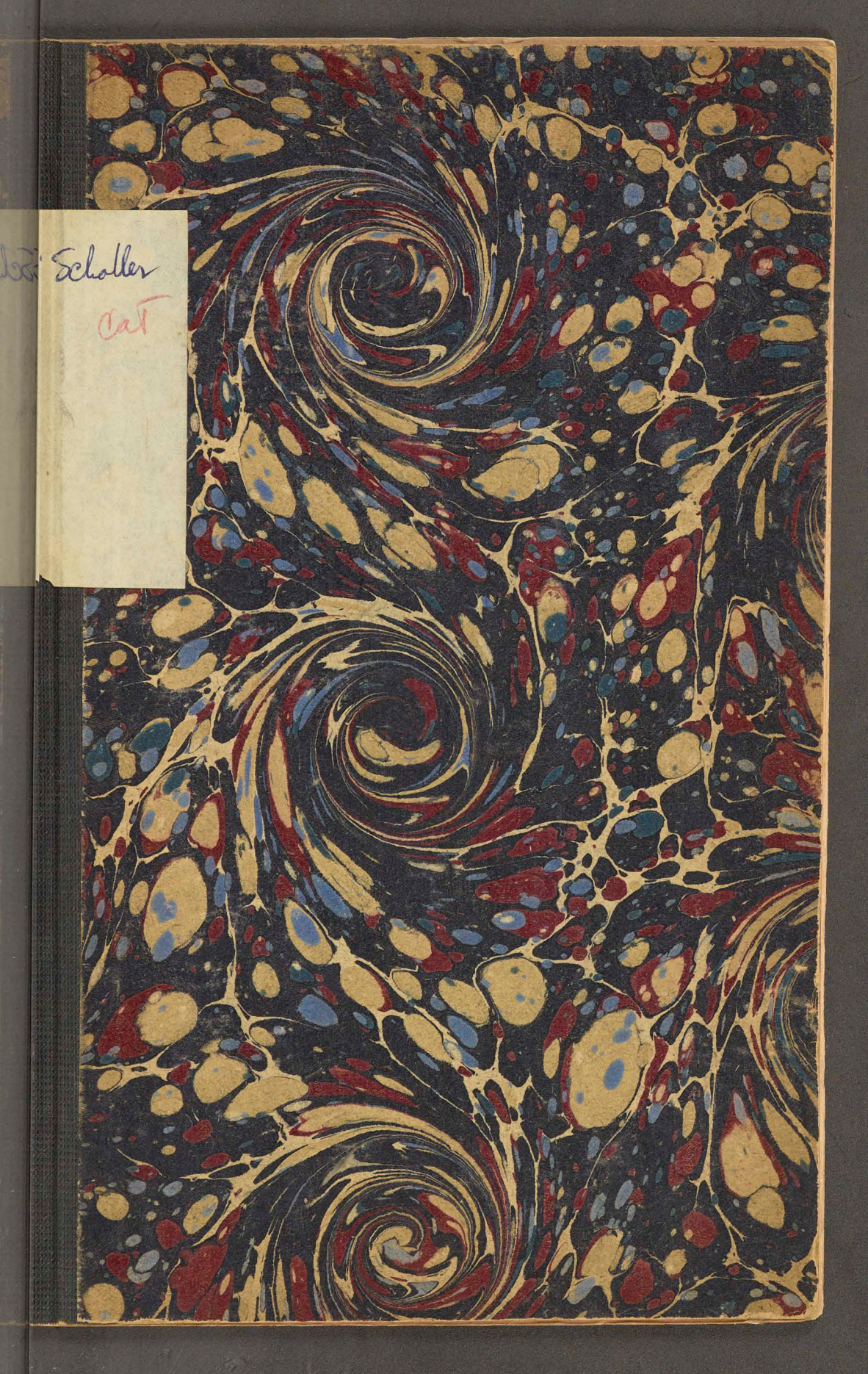
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SIDERITE AND BARITE FROM MARYLAND.

By Waldemar T. Schaller.

ART. XXXIII.—*Siderite and Barite from Maryland;* by WALDEMAR T. SCHALLER.*

Siderite.

A NUMBER of specimens of small splendent crystals of siderite were obtained through the courtesy of the Foote Mineral Company of Philadelphia, who give as the locality, "within two miles of Frostburg, Maryland." The crystals are very small and are deposited in great numbers on a gray massive siderite rock. A very striking feature of the crystals of siderite is the splendent play of colors that they show. They are very iridescent, and while their color is brown, the light reflected from the surfaces of the crystals is in all colors. Associated with the siderites and intermingled with them are numerous small barite crystals. The matrix is a compact impure iron carbonate having a specific gravity of 3·7. In this are imbedded occasional masses of white, opaque barite showing good cleavage. In the rock are numerous cavities which are lined with siderite and barite crystals, the specimens forming geodes, the crystals having been derived from the massive rock.

The crystals vary in size from those which are very minute to those a millimeter in size. They are mostly attached to the matrix by one end, though double terminated crystals are by no means rare, these being irregularly scattered through the mass. The entire layer of crystals is about a millimeter thick.

Chemical Properties.—A number of the crystals were broken from the specimens and very carefully selected from the matrix by hand. The crystals were freed from a small amount of barite by the electromagnet and finally about one-tenth of a gram of pure crystals was obtained, of which each crystal had been picked out and shown to be free from any foreign matter. It was noted that the crystals did not possess a uniform color, some of them being a much lighter brown than others. It was at first thought that the lighter colored ones contained calcium or magnesium, but such was found not to be the case. The change in the intensity of the brown color of the crystals cannot be solely due to the amount of iron in the crystals. The selected crystals were dissolved in hydrochloric acid and the iron precipitated with ammonia and weighed. Tests made for maganese, calcium and magnesium showed them to be absent. The weighed iron oxide was fused with sodium bisulphate, reduced and titrated with potassium permanganate, giving practically the same figure.

* Published by permission of the Director of the U. S. Geol. Survey.

FeO	62·01 (calc.—62·07% FeO)
MnO	none
CaO	none
MgO	none

The crystals are therefore pure iron carbonate and well suited for obtaining crystallographic constants for siderite.

Crystallographic Properties.—The siderite crystals have a rather unusual habit for that mineral, as the dominant form is the scalenohedron $v=\{21\bar{3}1\}$, the common form for calcite. A number of other forms are present, and a very marked feature of these crystals is that in approximately the places where the *a*-face would come there are rounded hollows. The crystals are highly polished and seemed likely to give perfect reflections, but on examination on the two-circle goniometer, it was found that the faces were not as perfect as was at first expected. This is due chiefly to the fact that some of the large scalenohedral faces appear broken and the parts slightly displaced, yielding more than one signal, several minutes apart. The crystals were mounted in polar position, and so adjusted that on turning the vertical circle (the horizontal one being clamped) the reflections from the several faces of each form fell, respectively, in a vertical line coinciding with the vertical cross hair. After the crystal was adjusted as perfectly as possible, the reading on the horizontal circle was taken for each face, the signal being brought to the exact center of the field in each case. The forms present are shown in the following table, those forms which are new for siderite being marked with an asterisk.

r	$10\bar{1}1$
**l*	$70\bar{7}5$
**k*	$50\bar{5}2$
f	$02\bar{2}1$
v	$21\bar{3}1$
**y*	$32\bar{5}1$

The new form $l=\{70\bar{7}5\}$ occurs but once as a small face below $\{10\bar{1}1\}$ but larger than that face. The reflection was fair.

	ϕ	ρ
meas.	0° 14′	52° 49′
calc.*	0° 00′	53° 07′

The form $k=\{50\bar{5}2\}$ occurs as a minute line face somewhat rounded, and truncating the edges of the scalenohedron $v=\{21\bar{3}1\}$. The measurements show that the ρ angle is about 68°, though no accurate measurement could be obtained.

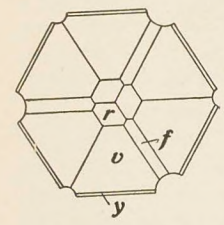
calc. (ρ) = 67° 12′

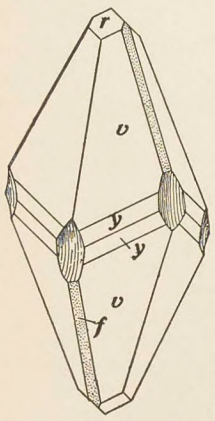
* From element derived by writer.

The unit rhombohedron r occurs on nearly all of the crystals as small faces truncating the apex of the crystals. The new scalenohedron $y = \{32\bar{5}1\}$ occurs on all the crystals and is a characteristic form for this locality. Though it varies in size, becoming relatively wide and short or narrow and long, its general form is shown in figure 1.

The zone $v\ y\ y^{VI}v^{VI}$ is sometimes somewhat striated between y and y^{VI}, and using the dot signal, it was seen that there was a maximum of brightness in the position required for the faces $\{7.6.\bar{1}\bar{3}.1\}$ and $\{11\bar{2}0\}$. It could not be shown, however, that these faces were actually present.

1





Siderite.

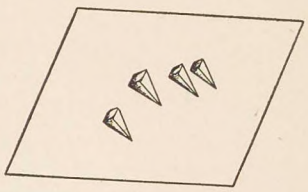
The form $f = \{02\bar{2}1\}$ occurs as broad dull faces giving no reflection and only an almost imperceptible haze of light. Measurements of the ρ-angle gave values from 59° to 62°, calc. 62° 17′.

The concavities give an indefinite blaze of light in the zone of the negative rhombohedrons, about 80° from the base, so that they do not reach down to the prism zone. A study of these hollows on the goniometer, using the dot signal, showed that they consisted of vertical striations approximating in the center of the form $\{06\bar{6}1\}$, and at the extreme edge to $\{11\bar{2}0\}$, with many forms in between these.

Fig. 1 is an attempt to illustrate the actual appearance of these crystals, showing, particularly, the concavities described. The indentations in the orthographic projection are somewhat exaggerated. With the exception of these and the broad dull faces of $\{02\bar{2}1\}$, the faces of the crystals are highly polished, and do not show any etching. It seems probable that these hollows should be regarded as the result of an incomplete or skeletal growth rather than as the result of etching. They are, in a way, analogous to the hopper-shaped crystals of sodium chloride, where the two faces 001 and 100 (in one zone) alternate and the resultant hollow has, in cross section, a V-shape. In the case of the siderites, however, instead of an alternation of the two faces, $06\bar{6}1$ and $11\bar{2}0$, there is a gradation from the prism to the rhombohedron and the result is a rounded hollow instead of a sharply angular one, as in the case of sodium chloride.

Etch Figures.—A cleavage piece was left standing in cold dilute hydrochloric acid for several days and then examined under the microscope, when well-defined etch figures could be observed. These are triangular in shape and possess a plane of symmetry parallel with the shorter diagonal of the cleavage rhomb of siderite, and are shown in figure 2. They resemble in symmetry the figures shown in Miers' Mineralogy (page 112) for calcite and not those given for dolomite. The symmetry of siderite is, therefore, the same as that of calcite and not that of dolomite, a conclusion sustained by the forms of the crystals.

2



Etch figures on cleavage surface of siderite.

Value for c-axis.—Although siderite is a common mineral, good crystals are rare and the literature on siderite is poor in crystallographic data. The only value for the axial ratio given and which is adopted in all books is one obtained in 1812 by Wollaston. His statement in regard to siderite is as follows:* "I have examined various specimens of this substance, some pure white, others brown, some transparent, others opake. That which gives the most distinct image by reflection is of a brownish hue, with the semi-transparency of horn. It was obtained from a tin mine, called Maudlin Mine, near Lostwithiel in Cornwall. By repeated measurements of small fragments of this specimen, the angle appears to be so nearly 107°, that I cannot form any judgment whether in perfect crystals it will prove to be greater or less than that angle.

In this instance the carbonate of iron is nearly pure, and so perfectly free from carbonate of lime . . . . . "

The measurements of the faces giving good reflections were used for calculating a value for the *c*-axis. The angles for the same form varied somewhat on different crystals, though the values obtained from the measurements of different forms agree very well with each other. From the average reading, the following values were calculated:

From	10	meas. of	$r = \{10\bar{1}1\}$,	$c = \cdot 82352$
"	27	" "	$v = \{21\bar{3}1\}$,	$c = \cdot 82463$
"	16	" "	$y = \{32\bar{5}1\}$,	$c = \cdot 82311$
			Average,	$c = \cdot 8240$

An attempt was made to measure the cleavage angle directly, but it was found that the resultant cleavage faces were never

* Phil. Trans., 159, 1812.

perfectly plane, with the result that each face gave several signals.

After this value for c was obtained and found to be different from the commonly accepted value, 10 more crystals were measured and after the greatest care in so adjusting each crystal that the reflections from the scalenohedral faces of v fell as nearly as possible in a straight line, each reflection was carefully measured. In the case of more than one signal, the extremes were measured and the average taken. The average value for the ρ angle for each crystal (six faces) is :

68° 14′	21′
26	27
18	20
15	19
16	29

Av. $68°20\frac{1}{2}'$, $\therefore c = \cdot 8243$

The values for the two extremes, 68° 14′ and 68° 29′, are :

$$c = \cdot 8197 \text{ and } c = \cdot 8302$$

Taking the average of the values found from r, v, y, namely, ·8240, and that found from the 10 crystals, namely, ·8243, we get as a value for the c-axis for siderite of known purity,

$$c = \cdot 8241$$

As however, this value differs considerably from that adopted for siderite and as the crystal faces were at times uneven and the angular measurements showed considerable variation, the writer is rather hesitant in urging this new value. It, at least, serves to throw some question over the commonly accepted value and shows the need of additional measurement of material shown by chemical analysis to be pure.

The complete lists of forms so far observed on siderite is as follows :

$c = 0001$	$k\dagger = 50\bar{5}2$	$d = 08\bar{8}1$
$m = 10\bar{1}0$	$M = 40\bar{4}1$	$\delta = 44\bar{8}6$
$a = 11\bar{2}0$	$e = 01\bar{1}2$	$a = 44\bar{8}3$
$g^* = 10\bar{1}2$	$h^* = 03\bar{3}2$	$v = 21\bar{3}1$
$z^* = 30\bar{3}4$	$f = 02\bar{2}1$	$\beta = 24\bar{6}1$
$r = 10\bar{1}1$	$\omega = 07\bar{7}3$	$y\dagger = 32\bar{5}1$
$l\dagger = 70\bar{7}5$	$s = 05\bar{5}1$	$i\ddagger = 41\bar{5}9$

Those with no reference mark are found in Dana's Mineralogy.

* Gonnard, Bull. Soc. Min., xviii, 382, 1895 ; also 1st supplement, Dana.
† The present paper.
‡ Cesàro, Ann. Soc. G. Belg., xviii, 1891 ; also 1st supplement Dana.

Barite.

The barite occurs in three different forms on the specimens seen by the writer. The first is the white massive form which is often imbedded in the matrix. It is usually opaque and shows good cleavage. The second form occurs as an opaque white efflorescence which is composed of an aggregate of minute crystals. The third form is present in transparent colorless crystals which often reach a length of several millimeters, though usually they are rather smaller. The largest ones seen were about a centimeter long and 1 to 2^{mm} thick. On some specimens these transparent crystals are attached by one end to the massive barite and form a fringe, as it were, around it, the crystals standing normal. This occurrence is very suggestive of a secondary formation of the crystals, they being derived from the massive barite in the matrix. The large clear crystals are probably a more perfect development than the white efflorescence and both are doubtless derived from the massive barite. In the massive barite there are no siderite crystals, though small fragments of the matrix are included therein, and in the efflorescence there are frequently found enclosed crystals of siderite, and the clear large barite crystals are intermingled with those of siderite.

The crystals of barite are of especial interest as they are of an uncommon habit; they are prismatic, elongated parallel to the vertical axis. Such crystals have been noticed several times but are not the common form for barite.

The faces of the crystals are highly polished and gave excellent signals. The prism zone is occasionally striated, especially the macropinacoid, though for the most part the zone is not striated and each face is distinct and plane. The forms present are:

$c = 001$	$m = 110$	$q = 114$
$b = 010$	$\eta = 320$	$f = 113$
$a = 100$	$\lambda = 210$	$r = 112$
$\chi = 130$	$o = 011$	$R = 223$
$B = 370$	$d = 102$	$z = 111$
$n = 120$	$l = 104$	$*N = 551$
$N = 230$	$v = 115$	$y = 122$

The prism $B = \{370\}$ occurs twice on two crystals as small faces, usually giving a fair reflection. The angles measured are as follows:

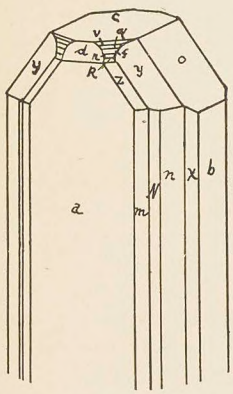
28° 09′, 27° 52′, 27° 45′, 27° 41′ calc. 27° 45′

The form was first noted by Düsing* and classed as doubtful by Dana and is not included in Goldschmidt's Winkeltabellen.

* Zeitschr. f. Kryst. xiv, 481, 1888.

The pyramid $N = \{551\}$ is new for barite,
meas. (ρ), 84° 55′, 84° 58′, 84° 08,′ 84° 45′ calc. (ρ) 84° 45′
It occurs as very small faces.

3



Barite.

The general ideal view of these crystals is shown in figure 3, though in detail the size of the various forms varies considerably even on the same crystal. There are, also, unusually more faces (line faces) in the prism zone than are shown in the figure. Occasionally the crystals are flat, parallel to the macropinacoid, but they are usually of equal diameter, horizontally. At times, too, one side of the terminated end is much larger than the other.

On account of the excellence of the signals, an axial ratio was calculated from the measurements. From the prism faces values for $\dot{a}$ were obtained and values for p_0 and q_0 were obtained from the pyramids and domes (the crystals being measured on the two-circle goniometer). From 44 values for $\dot{a}$ and 70 values for c, the following are obtained which come very close to the accepted value:

$$\dot{a} = \cdot 8146$$
$$c = 1 \cdot 3126.$$